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BOVINE TRICHOMONIASIS

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BOVINE TRICHOMONIASIS[1, 2]

HUGH S. CAMERON[3]

AMONG CATTLE DISEASES, those causing such genital disturbances as abortion and sterility probably result in the heaviest losses. In recent years, a protozoan, *Trichomonas foetus* (Riedmüller), has been incriminated as one cause of these two conditions. Although the incidence of this organism has not been determined, it probably ranks next to *Brucella abortus* as a cause of genital disease in cattle. Bovine trichomoniasis may be defined as a venereal disease caused by *Trichomonas foetus* and characterized by abortion, sterility, and pyometra (a condition characterized by an accumulation of pus in the uterus).

Genital diseases of unknown cause in herds free from Bang's disease have caused considerable loss in several sections of California. Because of numerous requests to the University of California, an investigation, which later became coöperative between the College of Agriculture and the United States Department of Agriculture Bureau of Animal Industry, was initiated in the San Joaquin Valley. Trichomoniasis was diagnosed in five herds that had reported breeding difficulties. Control measures for the elimination of the trichomonads increased the breeding efficiency. Because of the apparently growing importance of this disease in dairy herds, especially herds free from Bang's disease, the information about it has been compiled for the use of veterinarians and cattle owners. Although some of the information has already been published, a part is original and is largely based on recent investigations in the San Joaquin Valley.

DISTRIBUTION AND ECONOMIC IMPORTANCE

Bovine trichomoniasis has been reported from many European countries. In the United States, it was first recorded in 1932 by Emmerson in Pennsylvania (*1*).[4] Since then, it has appeared in numerous states, ranging from the eastern seaboard to the Pacific. In California it has been diagnosed by Traum[5] in one herd in Siskiyou County and by Schroeder[6] in

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[1] Received for publication March 29, 1938.

[2] The investigational work reported in this paper became coöperative with the United States Department of Agriculture Bureau of Animal Industry, February 1, 1937.

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[4] Italic numbers in parentheses refer to "Literature Cited" at the end of this bulletin.

[5] Traum, J. Personal communication.

[6] Schroeder, C. R. Personal communication.

two herds in San Diego County. The writer has observed it in one herd in Alameda County and in five herds in Tulare County. In these instances the organism was observed in genital exudate. Certain other herds in which the organism was not found presented a typical picture of trichomoniasis. Apparently the condition is widespread in California.

Being insidious, the infection is usually well established in a herd before it is observed. Losses, consequently, are heavy. Abelein, according to Stableforth and Scrogie (*2*), pronounces it the most common cause of sterility in his district of southwest Germany. Out of 168 cases of pyometra, trichomonads were observed in 144. In another herd, where no cause of breeding difficulties could be found except trichomonads, he reported that the percentage of cows with calf dropped from 96 to 26. The remaining 74 per cent, representing 49 cases, had breeding trouble. There were 6 cases of observed early abortion and 12 cases of pyometra. In a herd of 75 mature animals in New York (*3*), there were 9 observed abortions and 7 unobserved (a previous examination had revealed pregnancy) in 15 months. In an outbreak observed by Walsh, McNutt, and Murray (*4*), 133 services resulted in only 25 calves, an average of 5.3 services per calf. This compared with a previous record of 195 services for 128 calves, an average of 1.5 per calf. After the control of the outbreak, 97 services produced 50 calves, an average of 1.9 per calf. Gould (*5*) estimated the loss in a valuable herd of about 30 animals at over $10,000.

THE CAUSAL ORGANISM

Trichomonas foetus is a flagellated protozoan. Normally the body is somewhat spindle-shaped, 10 to 25 microns[7] in length, and about a third as wide. In other words, it is about a third larger than the head of a bovine sperm cell. It has three anterior flagella (fig. 1, *a*) arising from a common blepharoplast (fig. 1, *b*), and one posterior flagellum (fig. 1, *g*), a continuation of the edge of an undulating membrane (fig. 1, *e*).

In fresh preparations, the organism is actively motile, later becoming sluggish and more rounded. It is rapidly killed by drying and quickly loses its morphology so that it cannot be distinguished from cellular débris. Clearly stained specimens, therefore, are difficult to prepare unless one takes particular pains in the process of fixing. Figure 1 shows a diagrammatic sketch of *Trichomonas foetus;* figure 2, a photomicrograph of a stained specimen obtained from a case of pyometra.

The genus *Trichomonas* was first described in 1836, when one of its species (*Tr. vaginalis*) was observed in vaginitis of women. Since then many species have been described, the majority being saprophytes. The genus is widespread, being found in many different forms of life; it is described in Wenyon's *Protozoölogy* (*6*). *Tr. foetus,* the species that produces bovine trichomoniasis, has been studied in detail by Wenrich and Emmerson (*7*), who concluded that it was distinct from *Tr. vaginalis.*

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[7] 1 micron = 39.37 millionths of an inch.

Cultivation.—Although several workers report success, *Trichomonas foetus* is not easy to cultivate. Apparently Witte (*8*) was first to obtain the organism in pure culture. He concluded that he obtained the best growth in broth containing 5 to 10 per cent blood. Gehring and Murray (*9*) maintained cultures in Locke's egg medium with blood and 1–10,000 crystal violet. Glasser and Coria (*10*) purified trichomonads from bacteria by inoculating with the mixed culture one arm of a V tube containing 15 cc of sterile semisolid agar and one drop of defibrinated blood. After 16 to 20 hours at room temperature, a pure culture of trichomonads could be obtained from the other arm. Then it was cultivated on Locke's egg blood medium incubated at 37° C. Transfers were made every two weeks.

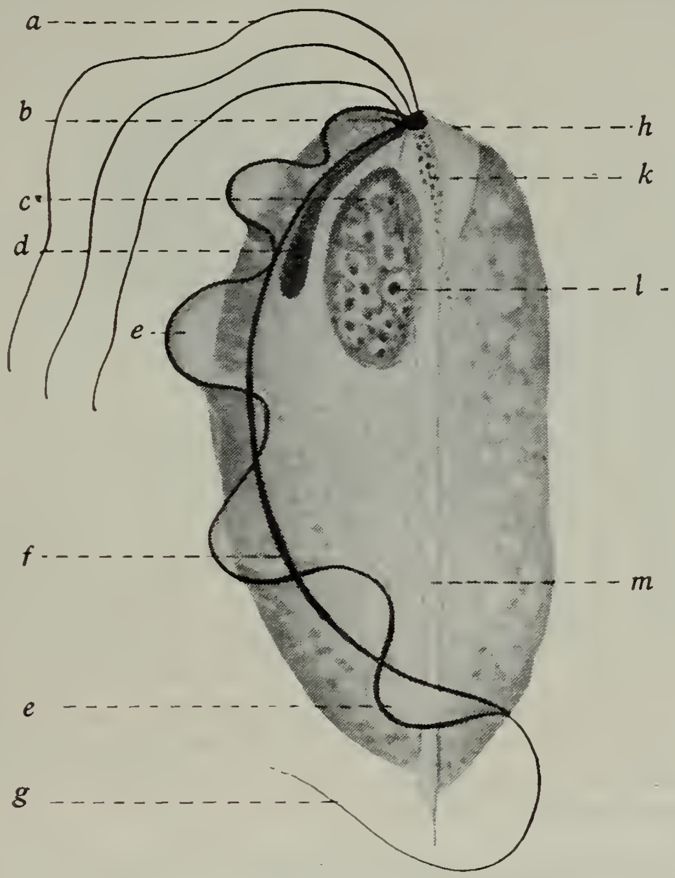

Fig. 1.—Diagram of *Trichomonas foetus* (Riedmüller): *a,* one of the three anterior flagella; *b,* blepharoplast; *c,* nucleus; *d,* parabasal body; *e,* undulating membrane; *f,* chromatic basal rod; *g,* posterior flagellum; *h,* cytostome; *k,* chromatic granules; *l,* karyosome; *m,* axostyle.

Pathogenicity.—Although most species of the genus are considered harmless, *Trichomonas foetus* is generally recognized as disease-producing. Drescher and Hopfengärtner (*11*) in 1933 considered the disease one of minor importance. They found trichomonads in only 9 per cent of 655 samples received on account of genital disease. Over half of the remaining cases, however, were not diagnosed. Abelein—according to Stableforth and Scrogie (*2*)—and others have not been able to observe the organism in a healthy genital tract. Witte (*12*) produced sterility in three heifers with intravaginal injections of bacteria-free cultures of trichomonads.

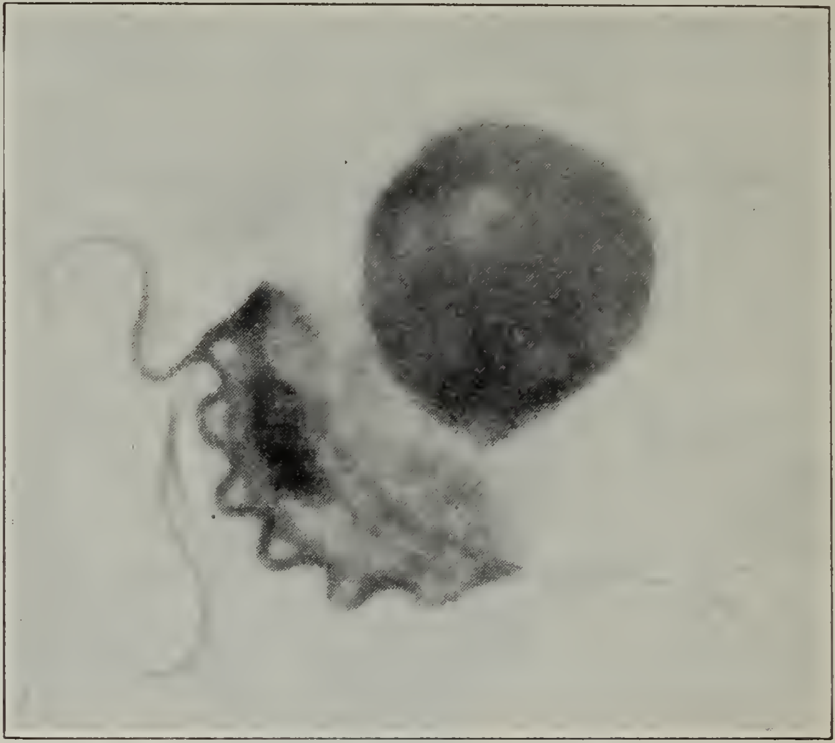

Fig. 2.—*Trichomonas foetus* (Riedmüller) accompanied by a piece of cellular débris. Photomicrograph of uterine exudate from a case of pyometra. (× 3,200.) Note undulating membrane on left side.

The writer (*3*), in a previous investigation, obtained uterine exudate aseptically from a case of pyometra. Although it was heavily infected with trichomonads, cultural methods revealed no bacteria. When similar methods were used in a case in Alameda County, again no bacteria were observed. Actively motile trichomonads obtained directly from a case of abortion produced temporary sterility in one heifer and abortion following temporary sterility in another; *Trichomonas foetus* was obtained from the uterine exudate at the time of abortion. Success in controlling the disease by eliminating the bulls that are spreading trichomonads further supports the view that *Trichomonas foetus* is a pathogen.

THE COURSE OF THE DISEASE

Apparently the principal means of transmission is by the bull during coitus. This conclusion (*3*) is based on findings in a large breeding herd free from *Brucella* infection. The herd was composed of six breeding units, which were stabled and pastured together so that, from a disease standpoint, there was no segregation. One or more bulls were assigned to each unit, and under no circumstances were these bulls changed from one unit to another; there was no crossbreeding between the units. Trichomonad infection was found only in the one unit that developed breeding difficulties.

When Walsh, McNutt, and Murray (*4*) attempted to transmit the infection to normal cows by pasturing them with a heifer that was discharging heavily infected pus, they found no evidence of spread. Andrews and Miller (*13*), on the other hand, observed the organism in the vaginas of virgin heifers that were mingling with infected cows. As with other venereal diseases, infection may perhaps occur in this way; but such an occurrence is probably rare. Infrequent elimination and the brief duration of viability in the vagina support the assumption that transmission by other than venereal means is rare.

Futamura (*14*) observed, at autopsy, *Trichomonas foetus* in the ampulla of the vas deferens of an infected bull. It can readily be found at the fornix of the sheath on autopsy and occasionally by swabbing the sheath of the living animal.

Apparently the organism does not interfere with conception, but the formation of a cervical seal creates conditions favorable for the propagation of trichomonads. Eventually the latter become so numerous that the fetus dies and may be expelled immediately. Frequently it is so small as to be unobserved. On the other hand, it may be retained in the uterus, undergo maceration, and result in pyometra. During pyometra, estrum is usually inhibited; and in its absence the cow is assumed to be pregnant. With the termination of pyometra, estrum occurs; and if bred while still infected, the cow may transmit the organism to a clean bull.

The source of the infection in a herd can usually be traced to the introduction into the herd of a bull used elsewhere or of a cow supposedly pregnant but really open, or to the acceptance of neighboring cows for service.

The prognosis of bovine trichomoniasis differs in the sexes: In the male it is very unfavorable, and recovery is rare. In the female the opposite obtains. The cow will discard the organism rapidly after the opening of the cervix. If not exposed to reinfection, she will completely recover.

SYMPTOMS AND DIAGNOSIS

Of the several symptoms associated with bovine trichomoniasis, none alone is diagnostic. Abortion—the most pronounced symptom—differs from that seen in Bang's disease: the fetus is usually in a macerated condition, having been dead in the uterus for some time, whereas in Bang's disease it usually appears normal and apparently has died only recently. The fetus may be so small that the abortion is unnoticed, and nothing is suspected until estrum reappears. In this case the condition is diagnosed as sterility rather than abortion. The predominating feature of the apparent sterility is delayed estrum. A period ranging usually from 30 to 90 days elapses between service and the return of estrum. Occasionally the period is longer—sometimes 8 or 9 months. In two cases during the Tulare investigations, the period extended beyond the date on which parturition was due.

Rectal examination for determining pregnancy usually reveals pyometra in the herd. Mucopus at the vulva, especially when the animal is lying down, is frequently observed. In character the discharge may vary from clear mucus with a few white spots to a thick brownish pus.

No apparent lesions are produced in the male genitalia. As mentioned in the discussion of transmission, the organism is readily found on autopsy in the fornix of the sheath. Quantity, motility, and morphology of the spermatozoa are not affected.

Any of the foregoing symptoms, especially if they occur sporadically, may be caused by agents other than *Trichomonas foetus.* If they appear as an epidemic, a presumptive diagnosis of trichomoniasis is justified. Since, however, the disease is insidious in its spread, accurate breeding records covering at least two years are essential before the herd history can be relied on for such a diagnosis. The following data accumulated from one of the herds in the San Joaquin Valley investigations presents a typical picture of bovine trichomoniasis.

Detailed breeding records were compiled from several herds reporting considerable sterility. These herds were free from *Brucella* infection and tuberculosis. Free access to breeding records and a willingness to follow recommendations were requested. Figure 3 shows the breeding chart used in collecting those data. When it was brought up to date from existing records, the owner was instructed to record all breedings, and calvings. If an animal was in estrum but not bred, this was recorded in the breeding column and distinguished by a circle around the date.

From such a record, the breeding efficiency of each bull was determined. Tables 1 and 2 give detailed breeding records of two bulls in

BREEDING AND CALVING SCHEDULE

DATE FROM ____________ TO ____________

COW NO.	DATE OF BIRTH	DATE OF LAST CALVING	DATE TO BREED	BULL TO USE	BREEDING DATES				DATE DUE	DATE CALVED	NO. SEX AND WEIGHT	DATE TO BREED	BULL TO USE	BREEDING DATES				DATE DUE	DATE CALVED	NO. SEX AND WEIGHT
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Fig. 3.—Breeding chart used in the San Joaquin Valley investigations, recommended to breeders for routine use. After Mead (*15*). Charts like this are furnished to members of California dairy herd improvement associations by the California Agricultural Extension Service.

TABLE 1

Record of Bull A

Date	Cow	Result*	Previous bull†	Date	Cow	Result*	Previous bull†
June 23, 1935	64	−	..	May 12, 1936	90	−	A
June 25, 1935	86	−	E	May 16, 1936	95	−	..
June 30, 1935	129	−	D	May 18, 1936	176	−	A
July 14, 1935	86	−	A	May 29, 1936	64	−	..
August 6, 1935	93	−	..	June 1, 1936	90	−	A
August 21, 1935	206	−	..	June 5, 1936	86	−	A
August 28, 1935	791	−	..	June 15, 1936	152	−	..
September 10, 1935	129	−	A	June 16, 1936	206	−	..
September 15, 1935	186	+	..	June 22, 1936	187	+	..
October 13, 1935	86	−	B	June 26, 1936	86	−	..
October 14, 1935	97	−	..	June 29, 1936	76	+	A
October 16, 1935	93	−	A	July 5, 1936	206	−	A
October 25, 1935	781	−	..	July 27, 1936	206	−	A
October 26, 1935	199	+	..	July 30, 1936	180	−	..
November 3, 1935	93	−	A	August 3, 1936	175	+	C
November 13, 1935	129	+	A	August 10, 1936	176	+	C
November 25, 1935	116	−	..	August 13, 1936	141	+	B
December 3, 1935	181	−	..	August 18, 1936	807	+	..
December 14, 1935	791	−	B	August 19, 1936	90	−	A
December 21, 1935	106	−	..	September 19, 1936	46	−	A
December 28, 1935	136	−	..	September 22, 1936	222	−	C
January 7, 1936	181	−	A	September 28, 1936	259	−	..
January 14, 1936	90	−	..	October 6, 1936	181	−	..
February 6, 1936	209	−	C	October 15, 1936	152	−	C
February 26, 1936	96	−	..	October 29, 1936	46	−	A
February 26, 1936	76	−	..	October 31, 1936	186	−	..
February 27, 1936	209	−	A	November 25, 1936	175	+	C
March 4, 1936	176	−	..	December 5, 1936	95	−	C
March 18, 1936	86	−	A	December 5, 1936	218	−	C
March 24, 1936	46	−	..	December 9, 1936	195	−	C
March 26, 1936	175	−	..	December 9, 1936	182	−	..
April 1, 1936	93	−	A	December 24, 1936	226	−	B
April 2, 1936	12	−	..	January 4, 1937	218	−	A
April 5, 1936	97	−	B	January 6, 1937	181	−	A
April 10, 1936	791	−	A	January 9, 1937	216	−	C
April 13, 1936	93	−	A	February 4, 1937	206	−	B
April 18, 1936	99	−	..	February 7, 1937	181	−	A
April 23, 1936	12	−	A	February 15, 1937	182	−	..
May 3, 1936	96	−	A	February 18, 1937	126	−	..
May 4, 1936	93	−	A				

* A plus sign indicates that a normal parturition resulted, a minus sign that it did not.

† If a repeat service, bull used at previous estrum.

herd B. All services by the bull were listed. If the result was a normal parturition, it was recorded +; otherwise —. For a repeat service, the bull used at the previous estrum was noted. The latter information was for epidemiological purposes and enabled the writer to ascertain which bulls were exposed.

Table 3 summarizes the records of four bulls, table 4 the results of pregnancy examinations on a group of cows in herd B, together with data obtained from the breeding records on a later date. Figure 4, a chart devised by Mead (*15*) and used with his permission, is a diagrammatic analysis and summary of the breeding history of all cows in the herd from April 1, 1932, to November 1, 1937. For comparison, figure 5 shows a similar analysis of a herd with a good breeding history.

As the epidemiology showed, the bull was a primary factor in the disease, and the symptoms in the cows resembled trichomoniasis. A presumptive diagnosis of such cases was made, consequently, and control measures were instituted.

TABLE 2

RECORD OF BULL B

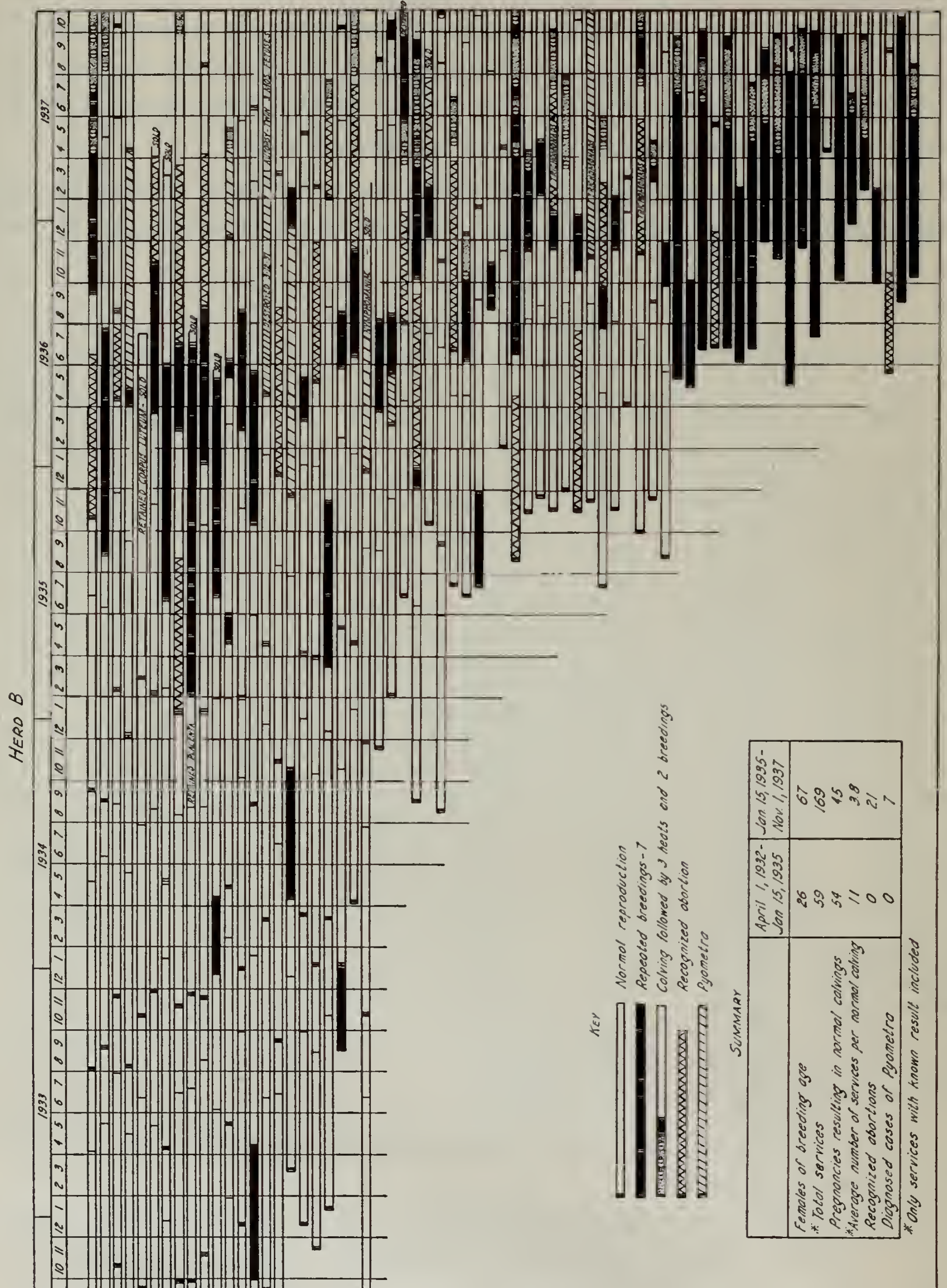
Date	Cow	Result*	Previous bull†	Date	Cow	Result*	Previous bull†
July 26, 1932	12	+	..	November 2, 1934	106	+	..
August 18, 1932	791	+	..	February 2, 1935	96	+	..
September 19, 1932	17	+	..	February 9, 1935	86	−	..
April 10, 1933	64	+	..	March 31, 1935	126	+	..
July 28, 1933	781	+	..	June 29, 1935	93	−	..
August 9, 1933	12	+	..	August 6, 1935	86	−	A
September 5, 1933	791	+	..	November 20, 1935	791	−	A
September 16, 1933	106	+	..	December 16, 1935	97	−	A
October 23, 1933	17	+	..	March 11, 1936	119	−	..
November 21, 1933	807	+	..	April 13, 1936	807	−	..
November 22, 1933	86	+	..	May 12, 1936	119	+	..
December 24, 1933	93	−	..	May 18, 1936	97	−	A
December 31, 1933	96	+	..	May 20, 1936	96	−	A
January 6, 1934	126	+	..	May 28, 1936	141	−	..
March 22, 1934	119	+	..	July 12, 1936	141	−	B
April 12, 1934	93	+	..	July 21, 1936	791	+	A
April 12, 1934	116	−	..	August 18, 1936	96	+	C
May 7, 1934	64	+	..	September 6, 1936	206	−	A
August 25, 1934	97	+	..	September 28, 1936	206	−	B
September 4, 1934	791	+	..	November 11, 1936	206	−	B
September 18, 1934	781	+	..	February 2, 1937	97	−	B

* A plus sign indicates that a normal parturition resulted, a minus sign that it did not.

† If a repeat service, bull used at previous estrum.

A positive diagnosis consists of finding *Trichomonas foetus* in genital exudate. Unfortunately, although the infection may be present in an animal, an examination of vaginal exudate, which is easiest to obtain, may be entirely negative. Vaginal infection is transient and will not persist for more than 24 hours. Exudate obtained directly from the uterus is more likely to contain the organism. Here, again, findings may be negative even in pyometra.

An opportunity was provided for a post-mortem examination of cow 99 (see table 4). This cow was bred on April 18, 1936. Since estrum did not appear, she was assumed to be pregnant. She did not, however, calve

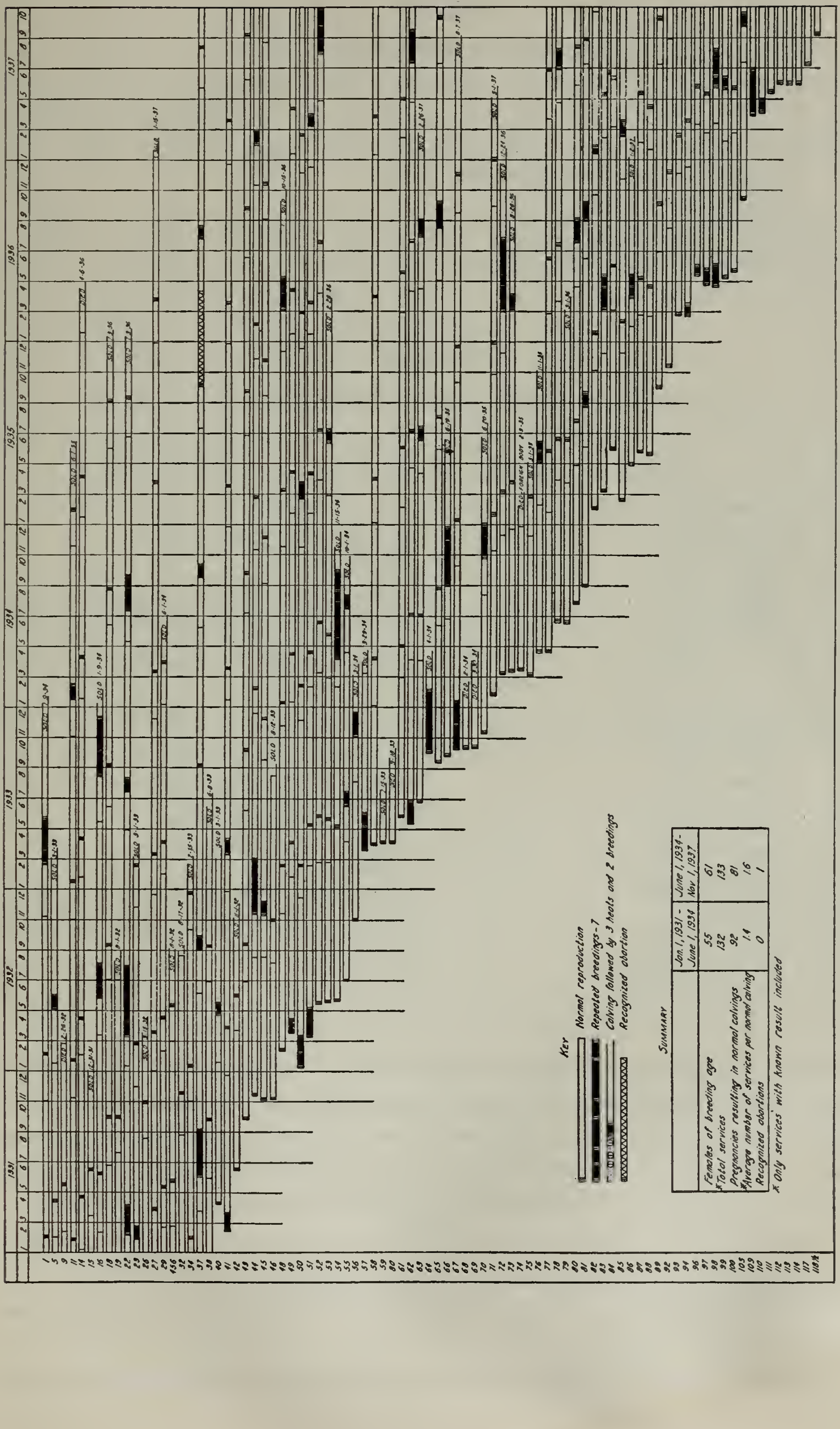


SUMMARY

	April 1, 1932- Jan 15, 1935	Jan 15, 1935- Nov. 1, 1937
Females of breeding age	26	67
* Total services	59	169
Pregnancies resulting in normal calvings	54	45
*Average number of services per normal calving	1.1	3.8
Recognized abortions	0	21
Diagnosed cases of Pyometra	0	7

* Only services with known result included

Fig. 4.—Diagrammatic analysis of breeding record in herd B; after Mead (15).



SUMMARY

	Jan. 1, 1931 - June 1, 1934	June 1, 1934 - Nov 1, 1937
Females of breeding age	55	61
*Total services	132	133
Pregnancies resulting in normal calvings	92	81
*Average number of services per normal calving	1.4	1.6
Recognized abortions	0	1

* Only services with known result included

Fig. 5.—Diagrammatic analysis of a herd showing a good breeding history; after Mead (*15*).

TABLE 3

Summary of Bull Records

Bull	Dates	Number of services	Normal parturitions
C	December 1, 1935, to February 11, 1937	31	5
A	June 30, 1935 to February 18, 1937	80	10
B	July 26, 1932 to June 9, 1935	26	23
	August 6, 1935 to February 2, 1937	16	3
D	July 4, 1932 to May 31, 1935	17	13

TABLE 4

Pregnancy Determinations as of March 11, 1937

Cow	Bred	Bull	Results	Subsequent data
781	January 1, 1937	A	Open	Bred four times since calving
791	July 21, 1936	B	Pregnant	Calved April 29, 1937
807	August 18, 1936	A	Pregnant	Calved May 29, 1937
12	April 23, 1936	A	Open	....
46	October 24, 1936	A	Pyometra	Aborted macerated fetus April 3, 1937
76	June 29, 1936	A	Pregnant	Calved March 22, 1937. Three weeks premature
90	August 19, 1936	A	Pyometra	Aborted well-developed fetus April 6, 1937
95	December 5, 1936	A	Open	Pus observed at vulva on previous date
96	August 18, 1936	B	Pregnant	Calved May 24, 1937
99	April 18, 1936	A	Pyometra	Confirmed on autopsy
141	August 13, 1936	A	Pregnant	Calved May 23, 1937
152	November 15, 1936	A	Pyometra	Aborted July 16, 1937
175	August 3, 1936	A	Pregnant	Calved May 9, 1937
176	August 10, 1936	A	Pregnant	Calved May 15, 1937
136	December 28, 1935	A	Pyometra	....
186	October 31, 1936	A	Pyometra	Estrum March 16, 1937
187	June 22, 1936	A	Pregnant	Aborted macerated fetus March 26, 1937
220	November 5, 1936	C	Pregnant	....
259	November 25, 1936	A	Pregnant	....
172	September 10, 1936	A	Pregnant	....

when due. Rectal examination on March 11, 1937, revealed a pyometra. Vaginal examination showed that the cervical seal was absent. Since the animal was of little value and had severe chronic mastitis, the owner wished to dispose of her. On autopsy, the uterus was comparable in size with that found in a 7-month pregnancy and contained several liters of fairly thin grayish puslike fluid resembling that found in trichomoniasis. The remnants of twin fetuses and their membranes were found; they showed a development of approximately 3 months. No trichomonads were observed in the fluid.

On the same day, from another herd, a comparable case was autopsied.

Here again no trichomonads were observed. Both these cows had been bred by bulls that later proved to be carriers of *Trichomonas foetus.*

The failure to find the organism at autopsy might be either because these animals had long been infected and the organism had died by autolysis, or because the disappearance of the cervical seal and the relaxation of the cervix provided conditions under which the organism could not survive.

Besides these autopsies, the exudate obtained by catheterizing the cervix in several cases of pyometra was examined. The organism was not observed. In all these cases the cervix was open. The examination of exudates began on March 11, 1937, but all were negative until May 19, 1937. On this date, rectal examination revealed a pyometra in cow 232, bred November 11, 1936 to bull C. When the cervix was catheterized, the uterine exudate proved to contain large numbers of *Trichomonas foetus.*

Since the organism cannot withstand adverse conditions, a single negative finding is inconclusive. The most reliable materials for examination are the exudate accompanying the abortion of a macerated fetus, and the exudate obtained by catheterizing the cervix in a case of pyometra. If, however, the cervix has been open for some time, the findings may be negative. Vaginal exudate is unreliable and will be negative even in an infected animal unless the organism has come from the uterus within the preceding 24 hours. Samples of vaginal exudate taken twice a week for several weeks from cows bred to a suspected bull will, however, probably reveal the organism if it is present.

The examinations should be made as soon after sampling as possible. The organism will remain viable in a glass container for as long as a week. The length of time depends on the amount of exudate, the number of organisms, the amount of bacterial contamination, and the temperature maintained. If the material is allowed to dry, the trichomonads will die and cannot be identified. Consequently, if the sample has to be mailed to a laboratory, a liberal amount of exudate should be collected—if possible, about 2 ounces. Should insufficient exudate be available, it should be diluted with sufficient physiological saline (or with tap water) to prevent drying before reaching the laboratory. As an excessive amount of bacterial growth will kill the trichomonads rapidly, the material should be maintained below the optimum temperature at which the common bacteria grow.

In examining the exudate under the microscope, one should use a low magnification, such as a 16-mm objective, for the preliminary examination. This provides a large field, and if only a few organisms are present, there is a much better chance of finding them there than in the small field under a higher magnification. A drop of the exudate is placed on a slide and examined before it has time to dry. If necessary, it may be diluted with physiological saline. *Trichomonas foetus* is actively motile and moves with jerky, irregular movements. Since protozoa are not normally present in the genital tract as they are in the digestive tract, this motility is deemed sufficient to warrant a diagnosis. For further confirmation, one may use a higher magnification and examine the organism in detail. The undulating membrane is characteristic of the genus. (See figs. 1 and 2, pp. 5 and 6).

To diagnose infection in the living male except by examination of breeding records is difficult. The method commonly used is to swab the sheath as deeply as possible with a pledget of absorbent cotton saturated with physiological saline on a pair of long forceps. After swabbing, the cotton should be placed in a vial containing enough saline to prevent drying before examination. This material is examined in the same manner as vaginal and uterine exudate. Since free-living and intestinal protozoa may be present on the prepuce, the finding of motile protozoa in the swab does not in itself justify a diagnosis. Unless the animal has a poor breeding record and unless *Trichomonas foetus* has been found in the herd, the protozoa obtained from the swab must be identified by a trained person. A poor breeding record plus the finding of the organism in the cow last bred to that bull is sufficient to condemn a bull as a carrier.

TREATMENT

There is no specific treatment for the disease in either the male or female. In the cow, symptoms should be treated as they appear. If, for example, pyometra is diagnosed on rectal examination, the corpus luteum should be expressed. This procedure will usually start uterine contractions and expel the pus and remnants of the fetus. The uterus may have to be irrigated with a mild antiseptic. If so, the fluid should be siphoned out at once rather than allowed to remain in the uterus. Siphoning may be accomplished by leaving the catheter in the cervix and massaging the uterus through the walls of the rectum.

The prolonged rest sometimes advocated for the male is of no value; infected bulls should be slaughtered.

CONTROL

In brief: the disease can be controlled by slaughtering the infected bulls and giving sexual rest to the exposed females. Cows that calved normally and have not since been bred are apparently not infected and may be bred to a clean bull. Virgin heifers may also be included in this group.

Cows bred to the infected bull since calving should not be rebred until they have gone through three normal estrous cycles. Since the organism will not remain viable in a nonpregnant uterus, there is little danger that these cows will spread the disease to a bull. It is wise, however, to use another bull for this group.

In herds where more than one bull is used, because of crossbreeding, the problem of determining which bull is the carrier arises. Records such as that shown in figure 3 are helpful in solving this problem.

Unwisely, many breeders use a different bull on the succeeding estrum if a cow fails to conceive on the first. Thus the second bull is exposed to any infection transmitted by the first. The breeding of an exposed cow by a clean bull may not always result in the bull's becoming infected. Cows eliminate the organism at the time of abortion or discharge of pus from the uterus; elimination may continue for several days; during this time estrum may appear, and the cow be bred. Under these circumstances, the chances of transmission are great. On the other hand, estrum may not appear until the trichomonads have disappeared; there will then be no transmission. Since, however, there is no way to determine whether or not the cow was infected with the organism when in estrum, one should not use bulls on cows bred at the preceding estrum by an infected bull.

After getting rid of all bulls known to be carriers, one should divide the cows into breeding units. Those that calved normally and have not since been bred constitute, along with the virgin heifers, the clean group or groups (according to the number of animals); to each group, a noninfected bull should be assigned. Cows bred at the preceding estrum to an infected bull comprise the exposed group; bulls exposed but not known to be infected may be assigned to these. Exposed cows, when first placed in a unit, should not be bred until the third normal estrum after being bred to a known infected bull.

Though isolation or segregation is unnecessary, there should be no crossbreeding between the groups. When a bull has been assigned to a group, services by him must be confined to that group. Thus, if an exposed bull is found to be infected, the disease will be confined to that group and will manifest itself in a relatively short time.

The essentials of control measures may be summarized as follows:

1. Slaughter all known infected bulls.
2. Divide cows into breeding units. Assign one bull to each unit, and do not crossbreed between units.
3. Cows that have calved normally and have not since been bred constitute with virgin heifers a clean group; assign a clean bull to this group.

4. Cows bred at the preceding estrum to an infected bull constitute the exposed group and should not be bred until the third normal estrum; to this group assign a bull exposed, but not known to be infected.
5. Maintain accurate breeding records for bulls and cows.
6. Provide competent examination for cows with breeding difficulties.

These control measures were adopted in the San Joaquin Valley investigations, not only in the herds where the organism was actually isolated, but also in several herds where, though the organism was not found, trichomoniasis was diagnosed tentatively because of the breeding history. The highly satisfactory results indicate that the epidemics of genital disease in herds free from Bang's disease in that area were due to trichomoniasis.

Strict adherence to these principles should eliminate trichomoniasis from a herd within a few months. From a hygienic standpoint it is advisable, however, to retain some precautions after the disease has disappeared. Since the estrous cycle is a good index of the health of the genital tract, cows showing an abnormal cycle should be examined before breeding. The practice of using another bull on a cow that has failed to conceive with the first bull should be abandoned. Thus if trichomoniasis does enter the herd, it will be confined to one group; and if clear and accurate breeding records are kept, an early diagnosis may be possible.

LITERATURE CITED

[1] EMMERSON, M. A.
1932. Trichomoniasis in cattle. Jour. Amer. Vet. Med. Assoc. **81**:636–40.

[2] STABLEFORTH, A. W., and N. J. SCROGIE.
1937. *Trichomonas* disease of cattle. Vet. Rec. **49**:211–25.

[3] CAMERON, H. S.
1935. Bovine trichomoniasis. Cornell Vet. **25**:99–110.

[4] WALSH, F. E., S. H. MCNUTT, and C. MURRAY.
1934. *Trichomonas bovis* infection in cattle. Cornell Vet. **24**:60–74.

[5] GOULD, G. N.
1937. *Trichomonas* disease of cattle. Vet. Rec. **49**:247–56.

[6] WENYON, C. M.
1926. Protozoology. Vol. 1. 778 p. Wm. Wood and Co., New York.

[7] WENRICH, D. H., and M. A. EMMERSON.
1933. Studies on the morphology of *Tritrichomonas foetus* (Riedmüller) (protozoa flagellata) from American cows. Jour. Morph. **55**:193–205.

[8] WITTE, J.
1933. Bakterienfreie Zuchtung von Trichomonaden aus dem Uterus des Rindes in einfachen Nährbaden. [Culture in a simple medium of bacteria free trichomonads from the uterus of cattle.] Zentbl. Bakt. orig., **128**:188–95.

[9] GEHRING, K., and C. MURRAY.
1933. The cultivation of *Trichomonas bovis*. Cornell Vet. **23**:335.

[10] GLASSER, R. W., and N. A. CORIA.
1935. The purification and culture of *Tritrichomonas foetus* (Riedmüller) from cows. Jour. Exp. Med. **22**:221–26.

[11] DRESCHER and HOPFENGÄRTNER.
1933. Der Trichomonaden abortus des Rindes. [Trichomonad abortion of cattle.] München Tierärtzl. Wchnschr. **84**:109–12.

[12] WITTE, J.
1934. Infektionsversuche an Rindern zur Klarung der pathogenen Bedeutung der Trichomonaden für die Sterilitat und den Frühabort des Rindes. [Experimental infection of cattle to determine the pathogenesis of trichomonads in sterility and early abortion.] Berlin Tierärtzl. Wchnschr. **50**:564–66.

[13] ANDREWS, JUSTIN, and FRED W. MILLER.
1936. Non-venereal transmission of *Trichomonas foetus* infection in cattle. Amer. Jour. Hyg. **24**:433–38.

[14] FUTAMURA, H.
1935. Studies on *Trichomonas* abortion in cattle. Jour. Japan Soc. Vet. Sci. **14**:392–416. (English summary.)

[15] MEAD, S. W.
1938. A diagrammatic method of presenting the history of reproduction in a dairy herd. Jour. Dairy Sci. **21**:283–87.

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